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ANALYSIS OF PROJECTED LEVELS OF TRAFFIC SERVICE BASED ON THE EXPANSION OF THE CIA HEADQUARTERS

TECHNICAL MEMORANDUM NO. 1
for the
CIA EXPANSION STUDY

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Virginia Department of Highways and Transportation

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OVERVIEW OF APPROACH TO THE TRAFFIC ANALYSIS

The purpose of the traffic analysis of the expansion of the CIA headquarters in Langley, Virginia, is to determine what highway and traffic facilities will be necessary to serve the added traffic demand. A traffic analysis primarily involves an examination of the relationship of the capacity of a roadway (how much traffic the road can carry) to the traffic demand on that roadway. The closer the traffic demand becomes to the road's capacity, the more delay and inconvenience is experienced by drivers, and the more the road is perceived as having a traffic "problem". The term "level of service" is used in the transportation profession to describe how well a road is serving the traffic demand.

Traffic problems are generally cured in one of two ways: reducing the traffic demand or increasing traffic capacity. Often, both are needed to adequately accommodate major expansion of traffic-generating land development. The CIA has indicated their desire to implement measures to limit the increase in traffic demand to the site. The traffic analysis described in this report serves to examine the projected impacts of this increase in traffic around the CIA site through the year 2005. This analysis involves the following steps:

1. Determine existing traffic volumes on roadway facilities within the study area. The study area includes Route 123 between Potomac School Road and the George Washington Parkway; the George Washington Parkway between I-495 and Route 123 and Route 193 in the vicinity of the CIA. The study area is shown in Figure 1.

2. Determine additional traffic volumes due to CIA expansion. Expansion is assumed to be in effect in 1986.

3. Project future changes in background (non-CIA) traffic.

4. Project total future traffic volumes, including all traffic, under various conditions or scenarios.

5. Conduct a level of service analysis to identify how well existing roadway facilities will be operating under the projected future increases in traffic.

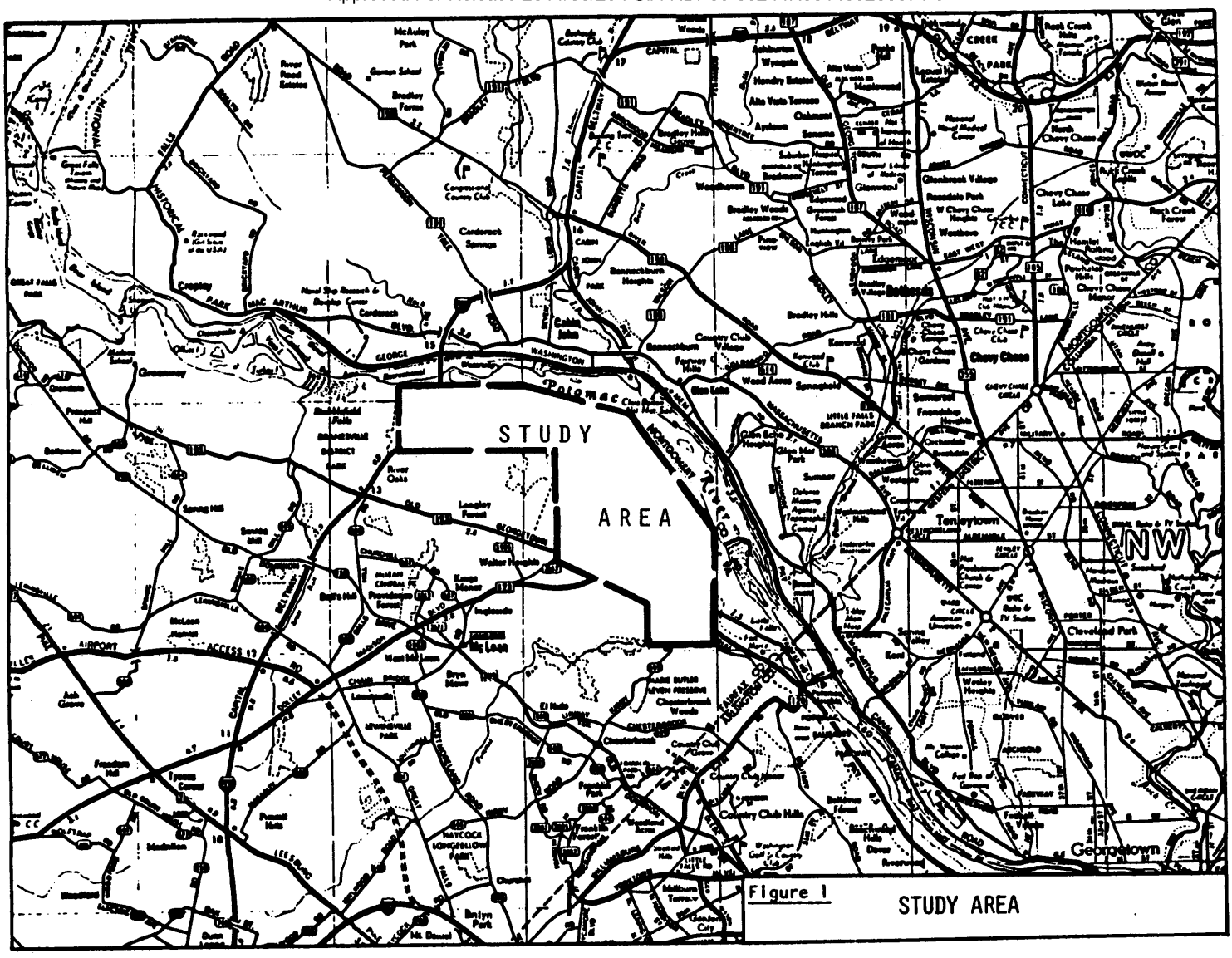

Figure 1 STUDY AREA

The steps outlined above will help in the identification of problem areas and of locations where improvements to the road system are likely to be necessary. This leads into the next step of the process, that is, looking at and evaluating alternative ways to make those improvements. That will be a topic of a future technical memorandum.

FUTURE CONDITIONS TO BE EXAMINED

In any prediction of the future, there is an element of uncertainty. This, of course, holds true for any prediction of traffic volumes. An important part of conducting a traffic analysis is examining a range of traffic conditions which may occur. The type of improvements required will vary depending on the possible future traffic conditions.

There are three possible conditions to be examined in this study:

1. Future traffic to CIA projected assuming that there is a capacity restraint at the I-495/George Washington Parkway interchange. Currently, the outbound ramps from the Parkway to I-495 operate near capacity in the PM peak traffic period. This condition assumes that, since these ramps are already close to saturation, all CIA expansion traffic would use Routes 123 and 193 to reach the site.

2. Future traffic to CIA projected assuming that there is no capacity restraint at the I-495/GW Parkway interchange. In this case, CIA expansion traffic would be distributed similar to the distribution of existing CIA traffic.

3. Future traffic to CIA projected assuming that there is no capacity restraint at the I-495/GW Parkway interchange and that all CIA expansion traffic uses the GW Parkway rather than Routes 123 and 193.

The above conditions are being examined for the years of 1986 and 2005. In addition, comparisons are made with existing traffic operation and with traffic operation in 2005 excluding CIA expansion traffic. The "no-expansion" condition is used strictly as a comparison with the expansion conditions to determine to what extent future traffic problems may be related directly to the expansion of the CIA. Traffic analyses are performed primarily for the AM and PM peak traffic hours. The analysis concentrates heavily on intersections and interchanges, since these are usually the most critical traffic bottlenecks.

TRAFFIC VOLUMES - EXISTING AND FORECAST

Figure 2 indicates the existing AM and PM peak hour traffic volumes for roadways in the study area. As would be expected, the limited access facilities (I-495 and the Parkway) carry substantially more volume than other facilities. Volumes on Routes 193 and 123 are heaviest toward the Parkway in the morning and away from the Parkway in the evening peak periods, with Route 123 carrying slightly more traffic.

Capacity analyses are normally done using AM and PM peak hour volumes. One way to evaluate the meaning of the existing volumes relative to roadway capacity is with the following rules of thumb:

1. For roadways unrestricted by signals and other features, the capacity is typically between 1800 and 2000 cars per lane per hour.

2. For ramps to and from a limited access highway, the capacity is typically 1500 to 1800 cars per lane per hour, with more sharply curved ramps having the lower value.

3. For intersections controlled by traffic signals, the maximum total number of vehicles which can pass through the intersection is 1500-1600 per lane per hour of green time on the signal.

Traffic forecasts were prepared by the Virginia Department of Highways and Transportation for the years 1986 and 2005 for the possible future traffic conditions. A number of assumptions were used in establishing these traffic forecasts. These include the following:

1. No growth in background (non-CIA) traffic between now and 1986. The basis for this assumption is the anticipated effect of improved roadway access in the I-66/Dulles Access Road corridor as well as the continued expansion of the Metrorail system.

2. An overall increase in traffic (background plus CIA expansion traffic) of approximately 1.5 percent per year on all roadways within the study area between 1986 and 2005. This rate of growth may be lower or higher for any one roadway in the study area based on its location and impact from CIA traffic.

3. Given no capacity restraints, the distribution of CIA expansion traffic on roadways to and from the site is assumed to be the same as for existing CIA traffic.

4. The amount of additional traffic generated by the CIA expansion is based on the CIA's having implemented measures to contain traffic demand. First, the

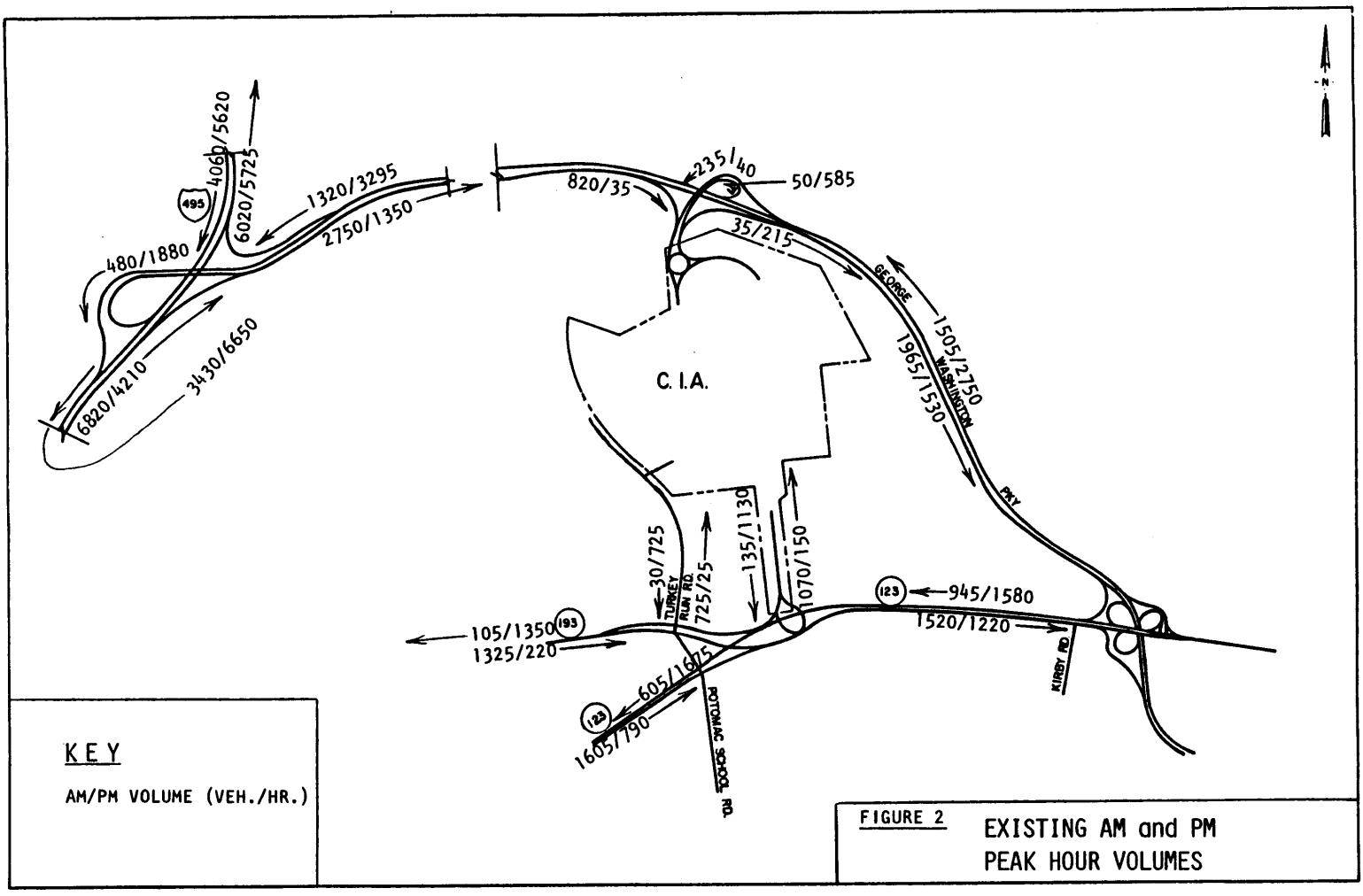

FIGURE 2 EXISTING AM and PM PEAK HOUR VOLUMES

increase in the number of parking spaces to be provided will be limited to approximately 1,000 spaces, in conformance with guidelines suggested by the National Capital Planning Commission. Complementing this will be strategies to substantially increase carpooling efforts as well as staggering work arrival and departure times to reduce the conflict with other commuting traffic. Approximately 1000 trips have been added to CIA traffic in each peak hour. This is approximately a 35 percent increase over existing levels, and should be conservatively high, given the types of demand reduction measures which are envisioned.

The forecast changes in traffic volume are presented in detail in the Appendix, for those readers who wish to review the numbers in detail. Figures A1 and A2 show the changes in traffic in percentage terms, while Tables A1 and A2 translate these into actual future traffic volumes. In general, the percentage increase in traffic on the various roadway links varies significantly for the alternative future conditions. In the 1986 forecast year, the greatest traffic volume changes occur on the exits and entrances to the CIA. Other than at the CIA entry points, volume increases are typically in the range of 2 to 20 percent over existing traffic. In the unrestrained traffic conditions, traffic volume increases are higher on the Parkway than they are under the capacity restrained condition. Increases are less substantial on Route 123 in the unrestrained conditions.

In the year 2005 forecast, percentage increases are higher, ranging between approximately 13 and 73 percent on various roadways. Route 123 incurs the largest increases in the restrained condition. In the conditions without capacity restraint, the George Washington Parkway links between the CIA and the Beltway again incur the most significant increases.

There are several conclusions one can draw from this analysis. First, it is clear that the alternative future traffic conditions have a significant impact on the distribution and levels of traffic on most of the roadways surrounding the CIA. The type of improvements needed for the road system may also be dependent on the condition assumed. Thus, it will be necessary as the study progresses to make some determination as to which condition or combination of conditions is likely to be most representative of actual traffic flows in the design years.

Another observation is that traffic volumes on Routes 123 and 193 are more significantly influenced, on a percentage basis, by the alternative future conditions than are the Parkway and the Beltway, due to the lower existing volume levels. The impact of adding a certain number of vehicles per hour on Route 193, for example,

would be greater than adding the same number of vehicles on the Parkway. Conversely, Route 123 currently has the ability to absorb more additional traffic than the Parkway, at least in the PM peak hour. The Parkway probably has more excess capacity in the AM peak hour. Thus, in actuality, the capacity restrained situation may apply in the PM peak hour only, at least for the 1986 design year.

LEVEL OF SERVICE ANALYSIS

Procedures

A level of service analysis is typically employed in a traffic study as a measure of how well roadway facilities are expected to operate under certain traffic and geometric conditions. In such an analysis, the roadways or intersections are assigned a letter rating between A and F, similar to a grade scale in school. An A is a good level of service while an F is a very poor level of service. Normally, one would like the highway system to operate at no worse than level of service D during the peak period. At this point, drivers feel the effects of heavy traffic volumes, but there are no extraordinary delays.

Freeway interchanges and signalized intersections are often the controlling factors as far as the levels of service are concerned. Levels of service are usually no worse between interchanges and intersections than they are at the interchanges and intersections themselves. The level of service at these locations is computed by comparing the traffic volume levels with the capacity available. The transportation profession has developed different procedures over the years for analyzing each type of situation. Currently, the most accepted procedures are found in Transportation Research Circular 212, entitled "Interim Materials on Highway Capacity".[1/] The procedures in this manual have been applied for the variety of capacity analysis situations examined.

A level of service analysis was performed for the AM and PM peak hours for selected intersections and interchanges in the study area. In all cases, the analysis assumed that there were no improvements to the existing roadway facilities. The

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1/ Transportation Research Board, Transportation Research Circular 212, "Interim Materials on Highway Capacity". January 1980.

purpose of this was to identify where the most significant traffic problems can be expected to occur. Based on this assessment, alternative ways of improving the roadways will be developed and additional level of service analyses will be performed as a later phase of the study.

Results of the Level of Service Analysis

Figures 3 and 4 indicate the results of the level of service analysis for the AM and PM peak hours, respectively. The figures display the existing levels as well as the levels for all future year conditions and assumes no improvements to the existing network. The impact of the CIA traffic can be examined in two basic ways: 1) comparing 1986 levels of service with existing (1983) levels and 2) comparing the 2005 condition without CIA expansion traffic to the other 2005 conditions.

The degree to which the addition of CIA expansion traffic influences the level of service depends on the future condition. The impact of the added traffic on Route 123 levels of service is obviously going to be more severe for the conditions involving capacity restraint on the Parkway. In the unrestrained conditions there is a lesser impact on Routes 123 and 193 and a greater impact on the Parkway. In general, the effect of CIA traffic is to reduce the level of service on Routes 123 and 193 by one to three levels under the restrained condition. The impact is most severe at the CIA entrance on Route 123, particularly in the A.M. peak hour.

In the 2005 design year, the assumed annual growth rate takes a significant toll on the level of service of all facilities. Under the restrained condition, the level of service on Routes 123 and 193 as well as on the Parkway is poor. Under these conditions there would be long queues of vehicles in the peak directions of flow if no improvements are made. If traffic demand grows at the assumed rate and no improvements are made to the I-495/Parkway interchange, queues would probably extend down the Parkway from I-495 to some point well south of the CIA interchange in the PM peak period. The sources of this congestion are the merge points of both ramps from the northbound Parkway to either direction on the Beltway.

The level of service analysis points out a number of particular locations where the future levels of service are not likely to be acceptable and where improvements are likely to be necessary. These problem areas are illustrated in Figure 5 and are itemized below:

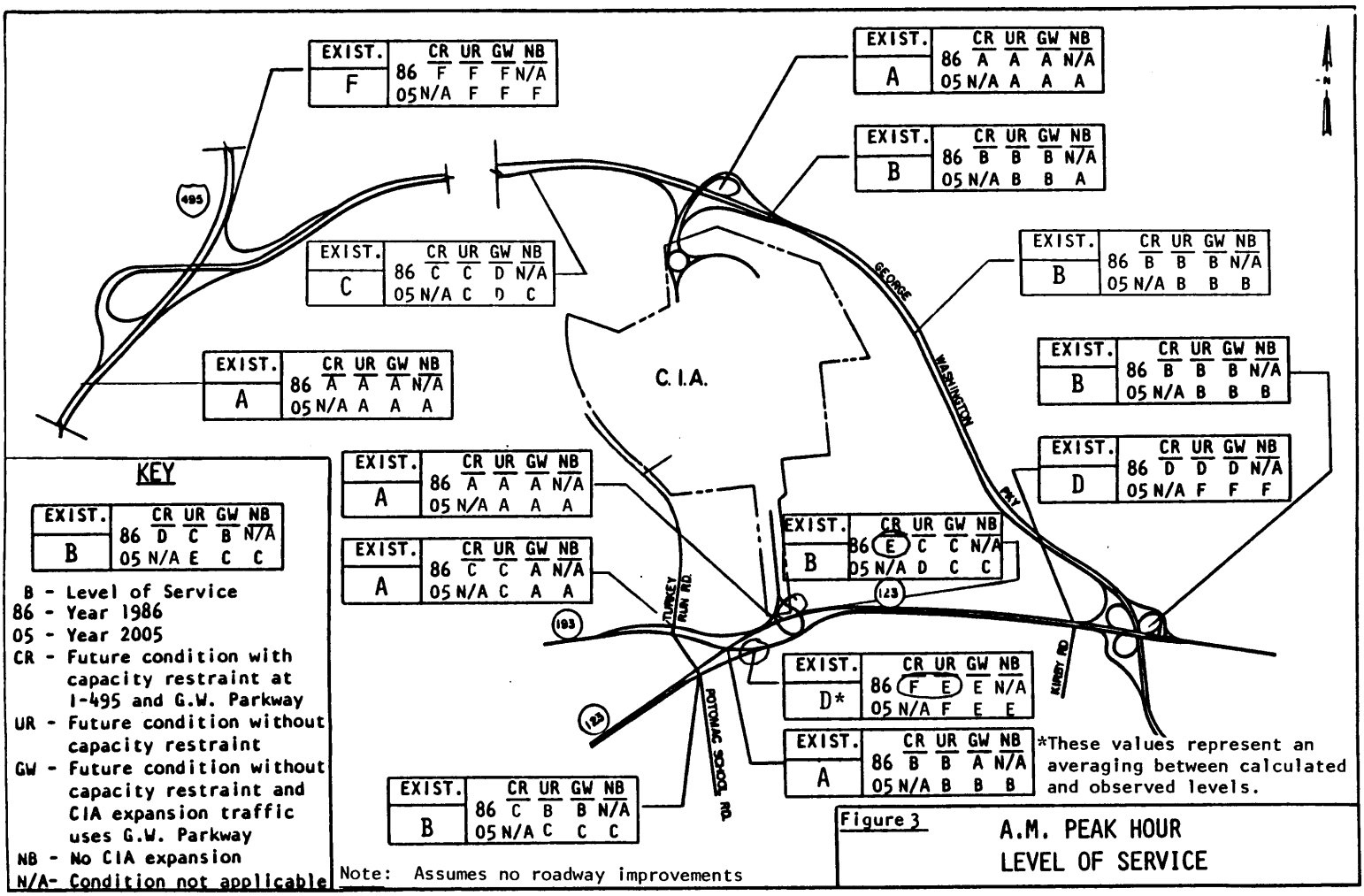
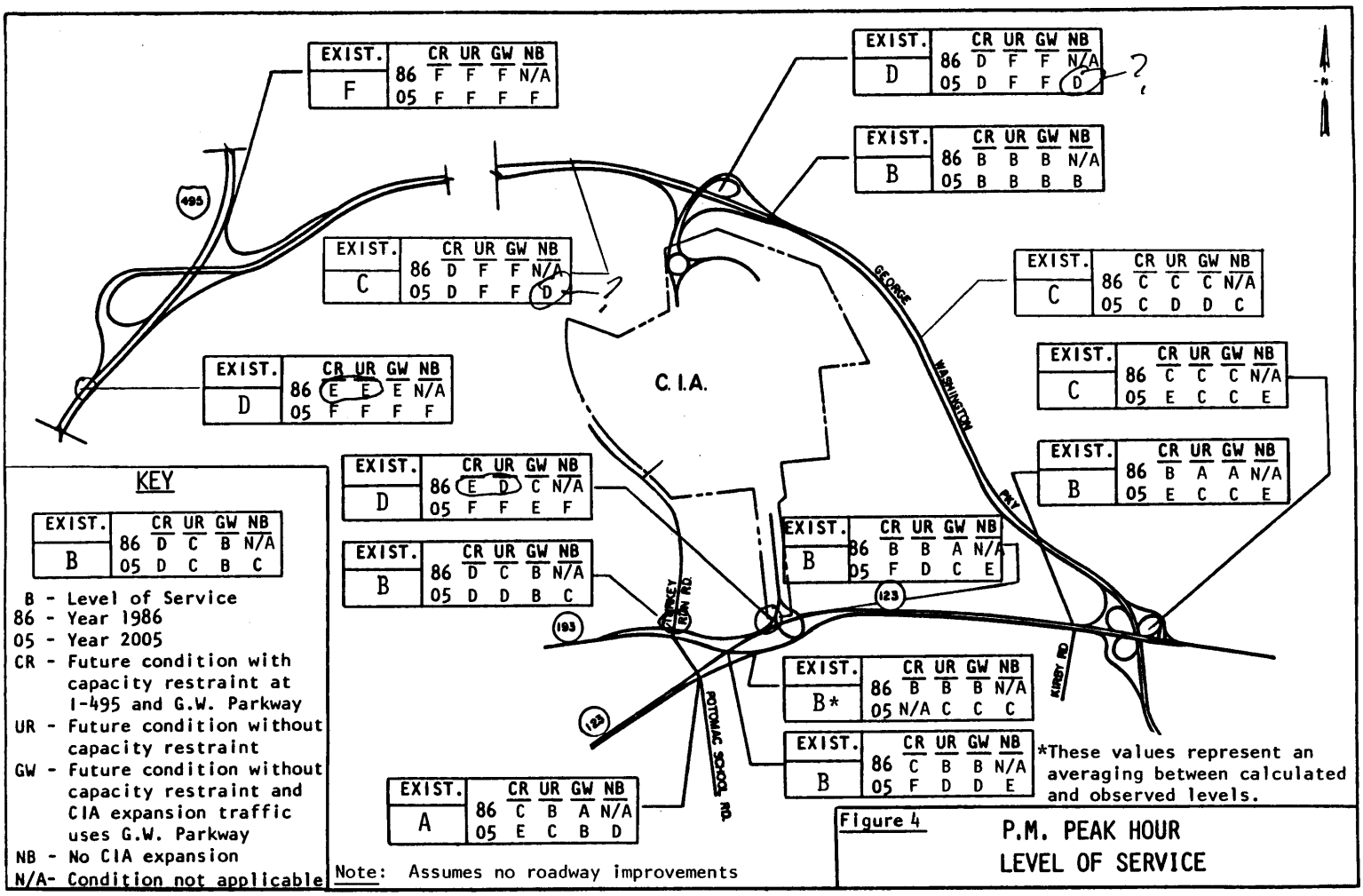


Figure 3 A.M. PEAK HOUR LEVEL OF SERVICE



KEY

EXIST.	CR	UR	GW	NB
B — 86	D	C	B	N/A
05	D	C	B	C

B - Level of Service
86 - Year 1986
05 - Year 2005
CR - Future condition with capacity restraint at I-495 and G.W. Parkway
UR - Future condition without capacity restraint
GW - Future condition without capacity restraint and CIA expansion traffic uses G.W. Parkway
NB - No CIA expansion
N/A- Condition not applicable

Note: Assumes no roadway improvements

*These values represent an averaging between calculated and observed levels.

Figure 4 P.M. PEAK HOUR LEVEL OF SERVICE

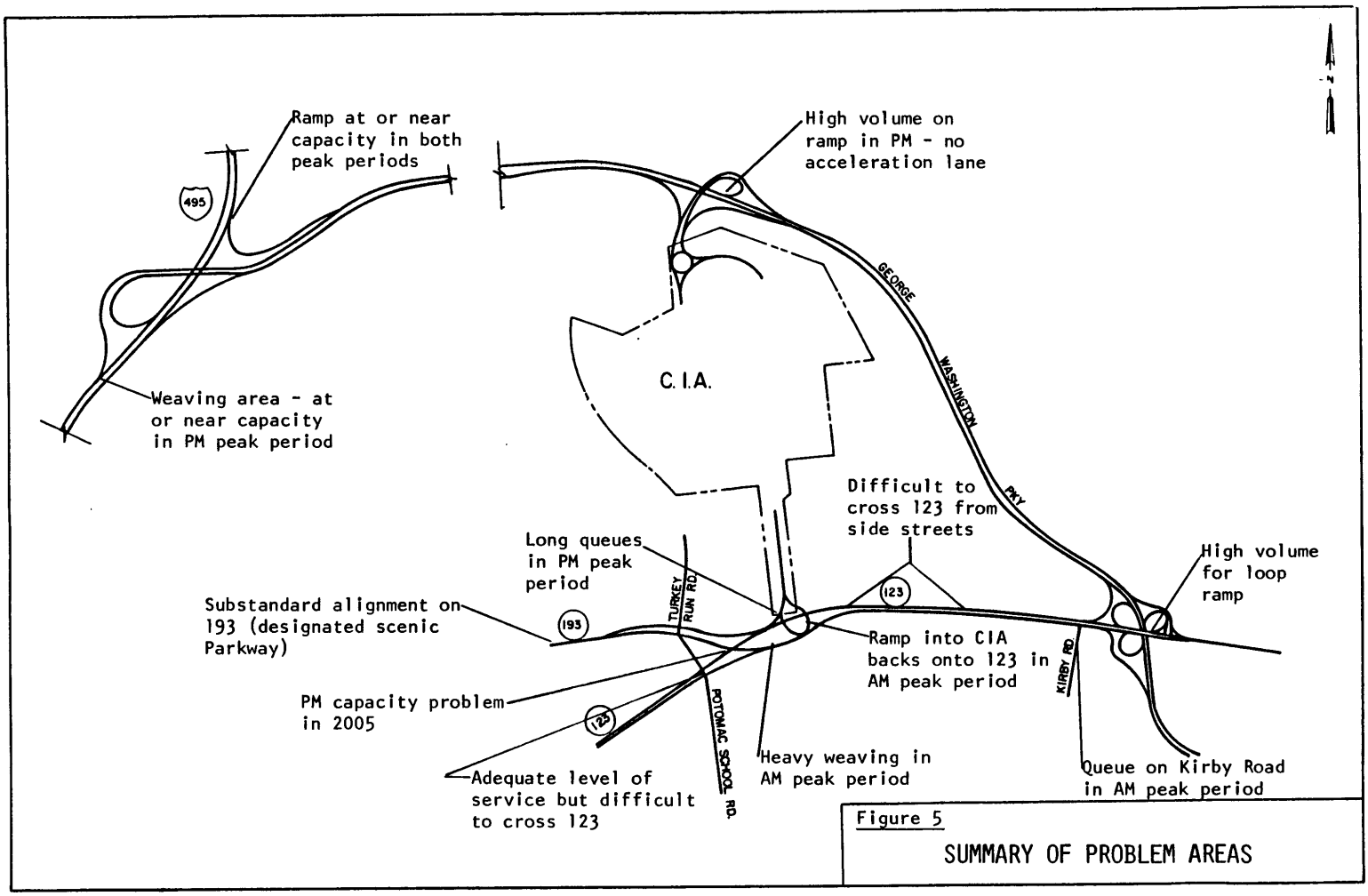


Figure 5

SUMMARY OF PROBLEM AREAS

1. Ramp from westbound Parkway to southbound I-495 - this ramp carries a heavy volume in the PM peak period. It is added to a heavy volume on the southbound Beltway and is actually part of a weaving section between the Parkway and the off-ramp to Route 193. This section is nearly operating at capacity now.

2. Ramp from westbound Parkway to northbound I-495 - this ramp merges into a three-lane section of the Beltway just before crossing the Cabin John Bridge. This ramp is also virtually at capacity now. Lanes would need to be added to the bridge for the capacity to be increased.

3. Ramps to and from the Parkway at the CIA interchange - the only ramp with traffic operational problems is the ramp from the CIA to the westbound Parkway in the PM peak period. Because of the heavy mainline volume on the Parkway at this time and because there is no acceleration lane for ramp traffic, merges are often difficult to make and the level of service is degraded. Improved operation and increased capacity would result from improving this ramp.

4. Intersection of Route 123 and the CIA main entrance - the level of service at this intersection is currently adequate. Queues are generally contained on the CIA premises, the primary exception to this being in the AM peak period when queues extend from the signal at the CIA entrance back to the Route 123 northbound roadway.1/ This queue sometimes conflicts with vehicles merging onto Route 123 from eastbound Route 193 in the AM peak period. The improvement of this weaving area is a problem which needs to be addressed. The queue out of the CIA headquarters in the PM peak period is long, but generally is moving at a steady pace, with relatively light delays to any one vehicle. As volume is added to this exit, however, green time may need to be taken from Route 123, which will cause the level of service on 123 to deteriorate.

5. Intersection of Route 193 and the Turkey Run access road - this intersection currently operates very well, with moderate queues out of the CIA in the PM peak period. Some minor modifications to this intersection could allow it to operate well for many years in the future. The rest of Route 193 to the west, which is primarily two lanes, was not originally designed to handle the amount of traffic it is carrying and should be considered for safety upgrading. There are plans to make such an upgrading without increasing the number of lanes on the road itself.

6. Other intersections along Route 123 - several other intersections being evaluated along Route 123 are at Potomac School Road, Route 193 and Kirby Road. There is no level of service problem at Potomac School Road, but there is a problem with being able to cross heavy streams of Route 123 traffic in the peak periods. This problem occurs at other unsignalized intersections with Route 123 as well. There is also no easy access from Potomac School Road (or from northbound Route 123) to westbound Route 193. Currently, vehicles must go down to the CIA/123 interchange and make

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1/ Note that Route 123 northbound is the direction going toward the Parkway.

a U-turn back to 193. The intersection of Route 193 and Route 123 southbound operates acceptably except for the year 2005 in the PM peak period. At Kirby Road, there is generally a long queue approaching Route 123 in the AM peak period. In the PM peak period there are typically no problems at this location.

The impact of the CIA expansion will be most apparent where traffic enters the CIA from the Parkway and Route 123. Here, it is the expansion traffic that would be the primary cause for any traffic improvements needed. At other locations, the cause of the traffic problems is less obvious. Improvements to the Parkway interchange with the Beltway will be needed with or without the expansion traffic. Several intersections along Route 123 will eventually need improvement even without the CIA expansion traffic. However, the expansion traffic is likely to make these improvements necessary at an earlier date. Specific improvements and their potential effects will be discussed in the next technical memorandum.

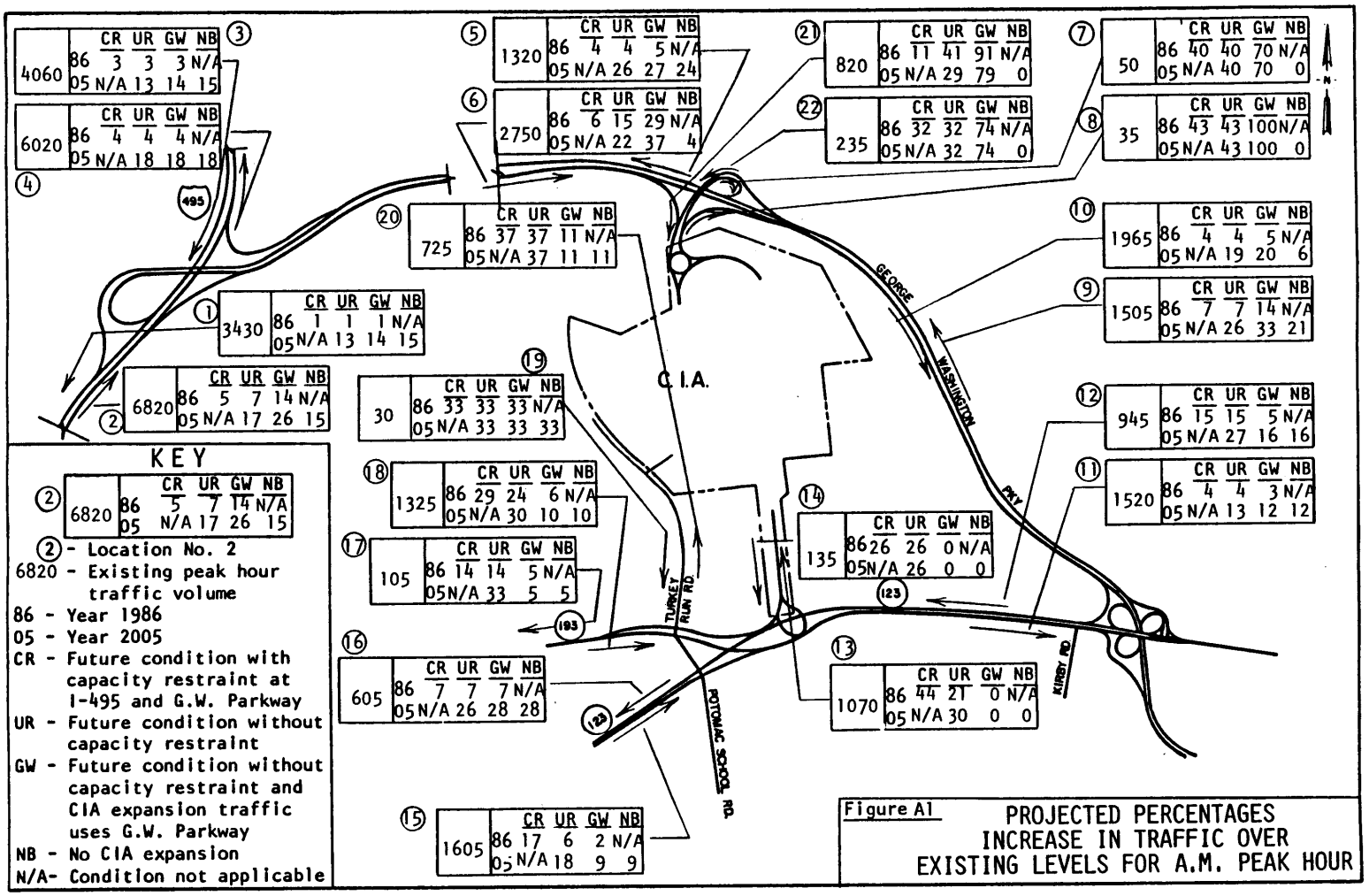

Figure A1 PROJECTED PERCENTAGES INCREASE IN TRAFFIC OVER EXISTING LEVELS FOR A.M. PEAK HOUR

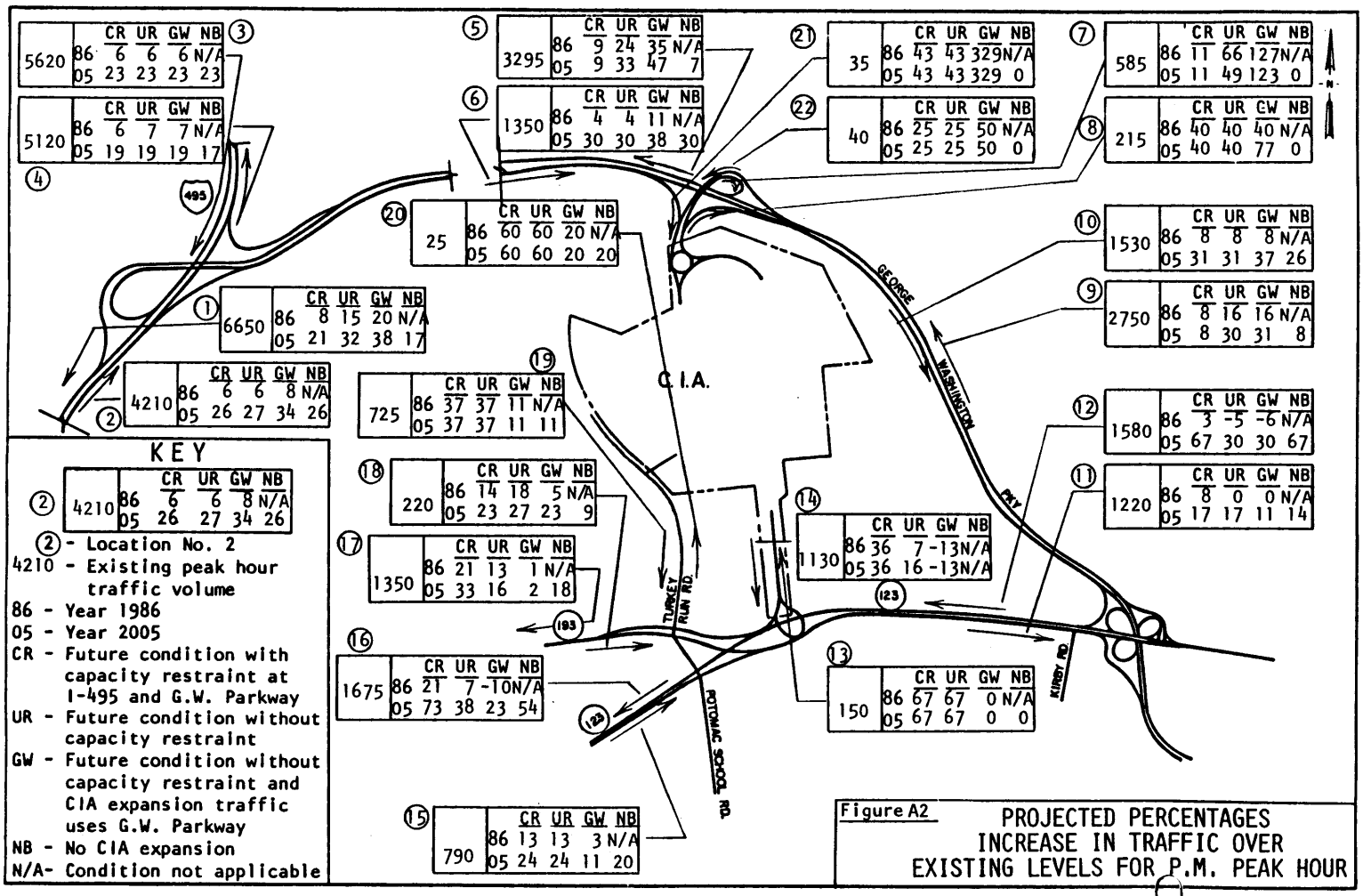

Figure A2 PROJECTED PERCENTAGES INCREASE IN TRAFFIC OVER EXISTING LEVELS FOR P.M. PEAK HOUR

Table A1. Traffic Volumes in AM Peak Hour

Location (see Fig. A1)	Existing	1986			2005		
		CR	UR	GW	UR	GW	NB
1	3,430	3,440	3,440	3,455	3,890	3,925	3,940
2	6,820	7,150	7,350	7,755	7,990	8,595	7,870
3	4,060	4,160	4,160	4,160	4,880	4,700	4,380
4	6,020	6,290	6,290	6,290	7,090	7,090	7,080
5	1,320	1,370	1,370	1,385	1,660	1,675	1,640
6	2,750	2,900	3,150	3,555	3,350	3,755	2,870
7	50	70	70	85	70	85	50
8	35	50	50	70	50	70	35
9	1,505	1,610	1,610	1,710	1,900	2,000	1,825
10	1,965	2,040	2,040	2,060	2,340	2,360	2,085
11	1,520	1,585	1,585	1,565	1,720	1,700	1,700
12	945	1,090	1,090	990	1,200	1,100	1,100
13	1,070	1,540	1,290	1,070	1,390	1,070	1,070
14	135	170	170	135	170	135	135
15	1,605	1,885	1,695	1,640	1,890	1,750	1,750
16	605	645	645	645	760	775	775
17	105	120	120	110	140	110	110
18	1,325	1,705	1,645	1,400	1,720	1,455	1,455
19	30	40	40	40	40	40	40
20	725	990	990	805	990	805	805
21	820	910	1,160	1,565	1,060	1,465	820
22	235	310	310	410	310	410	235

CR = With capacity restraint at I-495 and GW Parkway

UR = Without capacity restraint

GW = Without capacity restraint and CIA expansion traffic uses GW Parkway

NB = No CIA expansion

Table A2. Traffic Volumes in PM Peak Hour

Location (see Fig. A2)	Existing	1986			2005			
		CR	UR	GW	CR	UR	GW	NB
1	6,650	7,180	7,630	7,990	8,020	8,790	9,230	7,790
2	4,210	4,470	4,460	4,560	5,360	5,350	5,650	5,300
3	5,620	5,960	5,960	5,960	6,920	6,920	6,920	6,920
4	5,120	5,430	5,490	5,490	6,080	6,120	6,120	6,000
5	3,295	3,580	4,100	4,455	3,580	4,400	4,835	3,515
6	1,350	1,400	1,400	1,500	1,760	1,760	1,860	1,750
7	585	650	970	1,325	650	870	1,305	585
8	215	300	300	300	300	300	380	215
9	2,750	2,980	3,180	3,190	2,980	3,580	3,590	2,970
10	1,530	1,650	1,650	1,650	2,010	2,010	2,090	1,930
11	1,220	1,320	1,220	1,220	1,430	1,430	1,350	1,390
12	1,580	1,620	1,500	1,490	2,640	2,050	2,040	2,630
13	150	250	250	150	250	250	150	150
14	1,130	1,540	1,210	980	1,540	1,310	980	950
15	790	890	890	815	980	980	880	950
16	1,675	2,030	1,785	1,510	2,900	2,310	2,055	2,585
17	1,350	1,630	1,525	1,360	1,790	1,560	1,380	1,590
18	220	250	260	230	270	280	270	240
19	725	990	990	805	990	990	805	805
20	25	40	40	30	40	40	30	30
21	35	50	50	150	50	50	150	35
22	40	50	50	60	50	50	60	40

CR = With capacity restraint at I-495 and GW Parkway

UR = Without capacity restraint

GW = Without capacity restraint and CIA expansion traffic uses GW Parkway

NB = No CIA expansion

APPENDIX
TRAFFIC VOLUME FORECASTS

NOTE: Current year traffic volumes shown in the tables for I-495 differ from data published previously. Recent counts of Beltway traffic volumes reflect diversion of significant trips due to construction on the Woodrow Wilson Bridge, George Washington Parkway and Chain Bridge. This diversion resulted in a higher volume of traffic than would be normal based on historical trends. Consequently, these current volumes have been adjusted downward about 10% so as to present the normal base level condition. In addition, previously published volumes assumed that the current one-way road between Routes 193 and 123 was converted to a two-way operation in 1986. The volumes were revised assuming the current one-way operation is maintained, in order to be consistent with the rest of the analysis which was performed based on existing highway geometrics.